

## CLAIMS

1    1. A computer-implemented method to support in developing a process  
2 specification for a collaborative process involving distributed computer-based  
3 participant systems exchanging messages through an asynchronous messaging  
4 network, the method embodied by a computer program product executable by a  
5 computer system and causing, when executed, said computer system to carry out  
6 the steps of:

7                retrieving from a first storage location, sub-system state information on sub-  
8 system states and sub-system state transitions in relation to a plurality of software  
9 sub-systems of each participant system, said sub-system state information  
10 specifying in relation to each sub-system state transition, starting and target sub-  
11 system states of the corresponding software sub-system and events triggering,  
12 and resulting from, the respective sub-system state transition;

13                processing said retrieved sub-system state information to generate, and  
14 store in a second storage location, collaboration state information on collaboration  
15 states and collaboration state transitions of said process, said collaboration states  
16 being defined by a sub-system state for each software sub-system of each  
17 participant system and a communication status of each message exchangeable  
18 between said participant systems, said collaboration state transitions being  
19 determined based on said sub-system state transitions;

20                upon generation and storage of said collaboration state information,  
21 retrieving said collaboration state information from said second storage location;

22                processing said retrieved collaboration state information to generate  
23 information on incompletely specified terminal collaboration states among said  
24 collaboration states, an incompletely specified terminal collaboration state being a  
25 terminal collaboration state in which at least one message is underway between  
26 said participant systems; and

27                generating a result data object containing information on every incompletely  
28 specified terminal collaboration state found.

1    2.    The method of claim 1, wherein said step of processing said sub-system  
2 state information includes the steps of:

3                 processing said sub-system state information to generate, and store in a  
4 third storage location, local state information on local states and local state  
5 transitions of each participant system, said local state information specifying in  
6 relation to each local state transition, starting and target local states of the  
7 corresponding participant system and events triggering, and resulting from, the  
8 respective local state transition, said local states being defined by a sub-system  
9 state for each software sub-system of the respective participant system, said local  
10 state transitions being defined by applying said sub-system state transitions to said  
11 local states;

12                 upon generation and storage of said local state information, retrieving said  
13 local state information from said third storage location; and

14                 processing said retrieved local state information to generate said  
15 collaboration state information, said collaboration state transitions being  
16 determined by applying said local state transitions to said collaboration states.

1    3.    The method of claim 2, wherein said step of processing said sub-system  
2 state information includes the steps of:

3                 identifying an initial sub-system state from said sub-system states of each  
4 software sub-system; and

5                 generating said local state information by determining an initial local state  
6 for each participant system from said initial sub-system states of said software  
7 sub-system of the respective participant system, determining subsequent local  
8 states by applying said sub-system state transitions to said initial local states, and  
9 reiterating applying said sub-system state transitions to local states identified in a  
10 previous iteration until no further local states are found.

1    4.    The method of claim 2 or 3, wherein said step of processing said retrieved  
2 local state information includes generating, and storing in said second storage  
3 location, information on a set of virtual global states, said virtual global states  
4 being defined each by a local state for each participant system and a

5 communication status of each message, said set of virtual global states comprising  
6 states of any combination of local states of said participant systems and  
7 communication statuses of said messages.

1 5. The method of claim 4, wherein said virtual global states are represented  
2 each by a global state vector composed of first global state vector elements  
3 indicating a local state for each participant system and one or more second global  
4 state vector elements, one in relation to each message, each second global state  
5 vector element indicating a communication status of the respective message, said  
6 set of virtual global states comprising states of any combination of values of said  
7 first and second global state vector elements.

1 6. The method of claim 4 or 5, wherein said step of processing said retrieved  
2 local state information includes identifying an initial global state among said virtual  
3 global states, said initial global state being one in which at least one local state  
4 transition as specified by said local state information and involving a local trigger is  
5 applicable to said initial global state and no message is underway between said  
6 participant systems, said local state transition causing a global state transition from  
7 said initial global state to another virtual global state; determining every virtual  
8 global state reachable when starting from said initial global state; and determining  
9 said initial global state and every virtual global state reachable from said initial  
10 global state to be collaboration states.

1 7. The method of claim 3, wherein said step of processing said local state  
2 information includes the step of generating said collaboration state information by:  
3 determining an initial collaboration state, said initial collaboration state being  
4 defined by an initial local state for each participant system and a non-presence  
5 communication status of each message;  
6 determining subsequent collaboration states by applying said local state  
7 transitions to said initial collaboration state; and  
8 reiterating applying said local state transitions to collaboration states  
9 identified in a previous iteration until no further collaboration states are found.

1       8. A computer-implemented method to support in developing a process  
2 specification for a collaborative process involving distributed computer-based  
3 participant systems exchanging messages through an asynchronous messaging  
4 network, the method embodied by a computer program product executable by a  
5 computer system and causing, when executed, said computer system to carry out  
6 the steps of:

7             retrieving from a third storage location, local state information on local  
8 states and local state transitions in relation to each participant system, said local  
9 state information specifying in relation to each local state transition, starting and  
10 target local states of the corresponding participant system and events triggering,  
11 and resulting from, the respective local state transition;

12             processing said retrieved local state information to generate, and store in a  
13 second storage location, information on collaboration states and collaboration  
14 state transitions of said process, said collaboration states defined by a local state  
15 for each participant system and a communication status of each message  
16 exchangeable between said participant systems, said step of processing said local  
17 state information including the steps of identifying an initial local state from said  
18 local states of each participant system and generating said collaboration state  
19 information by:

20                 determining an initial collaboration state, said initial collaboration  
21 state being defined by said initial local state of each participant system and  
22 a non-presence communication status of each message;

23                 determining subsequent collaboration states by applying said local  
24 state transitions to said initial collaboration state; and

25                 reiterating applying said local state transitions to collaboration states  
26 identified in a previous iteration until no further collaboration states are  
27 found;

28             upon generation and storage of said collaboration state information,  
29 retrieving said collaboration state information from said second storage location;

30             processing said retrieved collaboration state information to generate  
31 information on incompletely specified terminal collaboration states among said

32 collaboration states, an incompletely specified terminal collaboration state being a  
33 terminal collaboration state in which at least one message is underway between  
34 said participant systems; and

35 generating a result data object containing information on every incompletely  
36 specified terminal collaboration state found.

1 9. The method of any of claims 1 to 8, further comprising the step of storing  
2 said result data object in a fourth storage location.

1 10. The method of any of claims 1 to 9, further comprising the step of providing  
2 said result data object to a graphical output device to visually present on a display  
3 a presentation object indicating every incompletely specified terminal collaboration  
4 state found.

1 11. The method of any of claims 1 to 10, wherein said communication status is  
2 a binary status indicating whether or not the respective message is underway  
3 between said participant systems.

1 12. A computer system to support in developing a process specification for a  
2 collaborative process involving distributed computer-based participant systems  
3 exchanging messages through an asynchronous messaging network, said  
4 computer system provided with a computer program product that, when executed,  
5 causes said computer system to carry out the steps of:

6 retrieving from a first storage location, sub-system state information on sub-  
7 system states and sub-system state transitions in relation to a plurality of software  
8 sub-systems of each participant system, said sub-system state information  
9 specifying in relation to each sub-system state transition, starting and target sub-  
10 system states of the corresponding software sub-system and events triggering,  
11 and resulting from, the respective sub-system state transition;

12 processing said retrieved sub-system state information to generate, and  
13 store in a second storage location, collaboration state information on collaboration  
14 states and collaboration state transitions of said process, said collaboration states  
15 being defined by a sub-system state for each software sub-system of each

16 participant system and a communication status of each message exchangeable  
17 between said participant systems, said collaboration state transitions being  
18 determined based on said sub-system state transitions;

19       upon generation and storage of said collaboration state information,  
20 retrieving said collaboration state information from said second storage location;

21       processing said retrieved collaboration state information to generate  
22 information on incompletely specified terminal collaboration states among said  
23 collaboration states, an incompletely specified terminal collaboration state being a  
24 terminal collaboration state in which at least one message is underway between  
25 said participant systems; and

26       generating a result data object containing information on every incompletely  
27 specified terminal collaboration state found.

1       13. A computer system to support in developing a process specification for a  
2 collaborative process involving distributed computer-based participant systems  
3 exchanging messages through an asynchronous messaging network, said  
4 computer system provided with a computer program product that, when executed,  
5 causes said computer system to carry out the steps of:

6       retrieving from a third storage location, local state information on local  
7 states and local state transitions in relation to each participant system, said local  
8 state information specifying in relation to each local state transition, starting and  
9 target local states of the corresponding participant system and events triggering,  
10 and resulting from, the respective local state transition;

11       processing said retrieved local state information to generate, and store in a  
12 second storage location, information on collaboration states and collaboration  
13 state transitions of said process, said collaboration states defined by a local state  
14 for each participant system and a communication status of each message  
15 exchangeable between said participant systems, said step of processing said local  
16 state information including the steps of identifying an initial local state from said  
17 local states of each participant system and generating said collaboration state  
18 information by:

19           determining an initial collaboration state, said initial collaboration  
20        state being defined by said initial local state of each participant system and  
21        a non-presence communication status of each message;

22           determining subsequent collaboration states by applying said local  
23        state transitions to said initial collaboration state; and

24           reiterating applying said local state transitions to collaboration states  
25        identified in a previous iteration until no further collaboration states are  
26        found;

27           upon generation and storage of said collaboration state information,  
28        retrieving said collaboration state information from said second storage location;

29           processing said retrieved collaboration state information to generate  
30        information on incompletely specified terminal collaboration states among said  
31        collaboration states, an incompletely specified terminal collaboration state being a  
32        terminal collaboration state in which at least one message is underway between  
33        said participant systems; and

34           generating a result data object containing information on every incompletely  
35        specified terminal collaboration state found.